[001] HEAT EXCHANGER INTEGRATED IN A TRANSMISSION

[002]

[003]

[004] The invention relates to a transmission comprising a heat exchanger pursuant to the preamble of claim 1.

[005]

[006] In modern vehicle transmissions with high loads, the transmission lubricant must be cooled to temperatures that are not critical for the system. Especially in surroundings with a high ambient temperature and for vehicles in which the transmission is encased for noise reduction reasons, corresponding cooling devices are provided in the form of a heat exchanger. The heat exchangers are typically used to additionally cool the transmission lubricant, but during the warm-up phase of the transmission they may also be used to warm up the transmission lubricant.

[007] The heat exchangers that are known today are either oil/air or oil/water heat exchangers and are mounted as additional components at a suitable location on the vehicle. Oil/water heat exchangers may also be integrated in the engine cooling system of the vehicle.

[008] From DE-A-196 25 357 has become known a heat exchanger integrated in a transmission where the heat exchanger represents part of the transmission case. The housing walls are in part interspersed with pipes in which oil and water circulate and the heat from the oil is conveyed to the water. The water lines as such are connected to the vehicle cooling unit. The transmission case itself here represents part of the heat exchanger.

[009] In EP-B-0 785 379 is described a transmission cooling system comprising a heat exchanger which is arranged uncovered in the oil sump of the transmission and conveys the heat of the ambient transmission lubricant to the cooling water of the vehicle engine. For this purpose, the vehicle cooling unit and the cooling lines of the vehicle engine are connected to the heat exchanger. The transmission cooling system comprises a transmission case, which accommodates the gear

wheels and defines an oil sump for the transmission lubricant – the oil. At least some of the gear wheels rotate inside the oil sump. In the oil sump of the transmission, only the oil that is located in the direct vicinity of the heat exchanger comes in contact with the heat exchanger and can convey its heat. There is no forced conduction of the oil present in the transmission past the heat exchanger for the purpose of conveying heat to it. Such conduction is consciously foregone by eliminating a pumping device suitable for conduction.

[010] It is the object of the invention to design a transmission cooling system that is more efficient.

[011] The object is achieved by means of a transmission comprising a heat exchanger having the features of claim 1. Embodiments thereof are disclosed in the dependent claims.

[012]

[013] According to the invention, a transmission has a transmission case that comprises an area in which the gear wheels rotate. The transmission additionally comprises a heat exchanger, which absorbs heat generated inside the transmission and transferred to a transmission lubricant and conveys this heat to a coolant in order to transport the heat away from the transmission. A recess, through which transmission lubricant flows and in which the heat exchanger is located, is provided in the transmission case that is located outside of the area in which the gear wheels rotate.

[014] Advantageously, the heat exchanger is a separate component that can be inserted in the recess in the transmission case.

[015] In an especially advantageous embodiment, transmission lubricant flows through the recess in the transmission case on the intake side of a pump transporting the transmission lubricant.

[016] One version of the embodiment shows that a bypass valve, which enables the heat exchanger to be bypassed when the temperatures of the transmission lubricant drop below a specified limit, is provided at the intake side of the pump transporting the transmission lubricant.

[017] For maintenance and assembly purposes, the heat exchanger in the recess is advantageously accessible from outside of the case. One embodiment shows the heat exchanger as a tubular heat exchanger.

[018] In one variation of the embodiment, the coolant is connected to a cooling unit outside of the transmission for transporting the heat away from the transmission. The embodiment is especially advantageous when the coolant used to transport the heat away from the transmission is a coolant within the cooling system of an internal combustion engine that drives the transmission.

[019] The coolant is preferably a water-based fluid and the transmission lubricant an oil-based fluid.

[020] By advantageously configuring and arranging the ducts for the transmission lubricant, the transmission case directly forms the housing for the heat exchanger. This results in the forced conduction of the entire transmission lubricant across the heat exchanger, thus improving the efficiency of the heat exchanger and achieving a clearly smaller and more compact design. By way of short ducts and a large cross-section of flow, which can be implemented by way of a systematic integration in the transmission case, a very small pressure drop is obtained. Only simple and economic adaptation parts are required in order to conduct the oil and to prove a seal and attachment. This guarantees a simple and reliable design also with respect to the connection of the coolant, without additional sealing elements.

[021] Despite the high level of integration, a retrofitting and removal is easily accomplished without having to disassemble the entire transmission. The simple design and a small number of interfaces lead to low manufacturing costs. At the same time, very good protection of the heat exchanger from damage or other mechanical influences is achieved.

[022]

[023] The invention will be explained in more detail based on drawings, wherein:

[024] Fig. 1 shows a schematic illustration of a vehicle;

[025] Fig. 2 shows a tubular heat exchanger;

[026] Fig. 3 shows the heat exchanger of Fig. 2 in installed condition;

[027] Fig. 4 shows a view of the transmission case, and

[028] Fig. 5 shows another view of the transmission case.

[029]

[030] Fig. 1 shows a schematic illustration of a vehicle 2 having a driving motor 4, which acts upon a transmission 8 by means of a friction clutch 6. The transmission 8 is connected via an output shaft 10 to a differential 12, which drives a vehicle wheel 16 via a full-floating axle 14. The friction clutch 6 is actuated by an actuator 18, which is connected to a control unit 22 via a signal line 20. The transmission 8 is actuated by a transmission controller 24, which is disposed on a case 26 of the transmission and is connected to the control unit 22 via a line 28. A heat exchanger, which is connected to the engine 4 and the coolant via two coolant lines 32 and 34, is installed in the case 26. The heated coolant is cooled down in a vehicle cooling unit 36. A cooling unit 38, which is mounted on the vehicle 2, can alternatively be connected to the heat exchanger 30 via the coolant lines 40 and 42, in which the coolant of the heat exchanger 30 is then cooled down. The heat exchanger 30 is connected to an oil sump 64 and an oil pump 62, which transports oil to gear wheels 66, 68 in an area of the transmission case 26. At oil temperatures below a specified limit, the transmission lubricant does not flow through the heat exchanger 30, but is pumped through a bypass valve 70, thus bypassing the heat exchanger 30.

[031] Fig. 2 shows the heat exchanger 30 which, in this example, is configured as a tubular heat exchanger. An inlet opening 44 is connected to one coolant line 32 and an outlet opening 46 is connected to the other coolant line 34.

[032] Fig. 3 shows the heat exchanger 30 integrated in the transmission case 26. The heat exchanger is simply held in place with a flange 52, which is sealed by washers 48 and 50 and is supported by a circlip 54. The washer 50 and flange 52 can also be configured as one piece with the heat exchanger 30. Coolant reaches the inside of the heat exchanger 30 via the openings 44 and 46. In the transmission case 26, the heat exchanger 30 is arranged in a recess 56 in such a way that the transmission lubricant drawn in by the oil pump 62 from the oil

sump 64 (Fig. 1) enters the recess 56 via an oil inlet opening 58 and can flow around the heat exchanger 30. The transmission lubricant leaves the recess 56 again force-fed at an oil outlet opening 60 and is drawn out in the direction of the oil pump 62.

[033] Fig. 4 shows a section of the transmission case 26 with the oil inlet opening 58, the oil outlet opening 60 and a fill opening 72 for the transmission lubricant. The heat exchanger 30, which is held in place by the flange 52 and the circlip 54, is positioned in the recess 56. The inlet opening 44 and outlet opening 46 for the coolant are shown at the heat exchanger 30.

[034] Finally, Fig. 5 illustrates a view into the recess 56 with the heat exchanger removed. The recess 56 clearly shows the oil inlet opening 58, the oil outlet opening 60 and the fill opening 72 for the transmission lubricant.

[035] By arranging the heat exchanger 30 in a recess 56 of the transmission case 26, through which the transmission lubricant is force-fed guided by way of the oil pump 62, is achieved an optimal cooling of the entire transmission lubricant.

Reference numerals

2	vehicle
4	driving motor
6	friction clutch
8	transmission
10	output shaft
12	differential
14	full-floating axle
16	vehicle wheel
18	actuator
20	signal line
22	control unit
24	transmission controller
26	case
28	line
30	heat exchanger
32	coolant line
34	coolant line
36	vehicle cooling unit
38	cooling unit
40	coolant line
42	coolant line
44	inlet opening
46	outlet opening
48	washer
50	washer
52	flange
54	circlip
56	recess
58	oil inlet opening
60	oil outlet opening
62	oil pump
64	oil sump
66	gear wheel
68	gear wheel
70	bypass valve
72	fill opening